



Ethical Values and Biological Diversity: A Preliminary Assessment Approach †

Joel I. Cohen

Parkland Magnet Middle School, Rockville, MD 20853

INTRODUCTION

There have been five major extinction events over geological time. However, the current rate of extinction or reduction of species and their habitats is directly related to human actions. As this trend continues, difficult practical and ethical decisions regarding the value of life come to the forefront. For seventh grade students, biodiversity is introduced during biology or life science courses, often as an extension of evolution, natural selection, and descent from common ancestry. However, the ethical implications of humanity's role in this most recent loss of diversity are seldom considered.

As part of a short biodiversity unit, a survey was developed for students to express their ethical values regarding conservation of biodiversity or protection of species. The unit spanned four class periods, combining species diversity science, the plight of endangered species and their protection, a living reptile program presented in the classroom, poster art supporting protection of a specific species, and the ethics survey. This unit was piloted in the 2013–2014 school term. Student responses to questions on the ethics survey were taken before and after the unit's completion. An unexpectedly high level of interest in, concern for, and understanding of the relationship between human actions and the plight of endangered species was noted. This was expressed in the student assessment of the reptile program and consistent high scoring on the ethics survey.

Ethics arrives at the forefront of biodiversity, as concerns for conservation and preservation often stem from ethical or moral values aimed at combating the destruction of this planet's resources. Science teaching relies on the presentation of scientific facts, even though some of these may be open to heated debate. However, in the case of biodiversity, the presence of scientific fact alone has not been enough to change actions or approaches to avoid the acidification of the oceans, reduce the accumulation of carbon dioxide in the atmosphere, or curtail the current human-caused species extinction rates (4). As with many

developments in biotechnology, science alone is not shaping public opinion or legislation (3), and students are exposed to genetic screening and counseling for which ethical codes or ethical choices are still being established. We can expect the same to be true for preservation and conservation of endangered species.

PROCEDURE

This unit was prepared for secondary science, specifically for seventh graders in a life science/biology course. The students met every other day for four 90-minute blocks. Over these four periods, lessons included readings, discussion, endangered animal poster construction, a live animal program, and an explanation of an ethics survey. The ethnic or cultural background of the students at the time of the survey was: Hispanic 26, African-American 12, Asian 27, Caucasian 6, and those of mixed ethnic backgrounds 19, totaling 90. This included four advanced classes and one on-level class, with a gender ratio of 43 males to 47 females.

As this unit had not been taught before, special time was taken to explain objectives before starting. The objectives were written to include specific deliverables and demonstration of knowledge, aiding students to:

1. Describe what is meant by biodiversity and its relation to our studies on descent with modification, as presented in a short-essay response
2. Understand the meaning and difference between endangered, extinct, and threatened species by making a poster on a species and explaining why and how it fits the classifications
3. Complete a species organizer for the animals presented during the reptile program, including their natural home, whether they are endangered or threatened, and their scientific and common name
4. Determine ethical positions for biodiversity by completing an anonymous survey before and after the unit

In teaching science, we rely on the presentation of scientific facts. However, presenting facts alone is not always enough to change actions or approaches, as is evident in

Corresponding author. Mailing address: Parkland Magnet Middle School, 4610 West Frankfort Drive, Rockville MD 20853. Phone: 301-438-5700. Fax: 301-460-2699. E-mail: cohenji@comcast.net.
†Supplemental materials available at <http://jmbe.asm.org>

teaching biodiversity, where education has not led to avoiding the acidification of the oceans, reducing the accumulation of carbon dioxide in the atmosphere, or curtailing the current human-caused species extinction rates (1). Science teachers are content specialists who can teach the scientific underpinnings of biodiversity but have much less experience introducing ethical questions that allow our students to contemplate what biodiversity and conservation mean and to explore the personal values associated with their opinions.

To address the above concern, a learning cycle lesson plan incorporated the unit's unique key features (Table 1). Using this format meant that the unit was familiar, using four of the 5 Es (engagement, exploration, explanation, and evaluation) as presented (2). Before engagement began, students participated in the anonymous ethical survey on values and beliefs they hold regarding biodiversity. This was a 15-question survey focusing on ethical questions, values, and judgments, and it was repeated at the end of the unit. Each question was first read aloud and students could ask for clarification. A discussion on ethics was also held, so that students felt comfortable before starting the survey. Students were told that there was no right or wrong answer, and that results would be looked at in aggregate, with no one getting a grade.

DISCUSSION

While the unit focused primarily on the science underlying biodiversity and endangered versus extinct species, an ethical survey was added to determine student values as to whether or not, and under what conditions, the conservation of biodiversity might occur. In part, the unit was structured on the premise that a first-hand encounter with diversity of living organisms would lead to an enhanced understanding of life on earth and threats and dangers to species, including habitat destruction caused by humans. Approximately 60 out of 90 students believed that the presence of the live reptile program in the classroom was key to expanding their understanding of biodiversity, as shown from survey question 13 (Table 2). In addition, content knowledge can be seen in answers to the last question, where 83% selected the correct answer as to the importance of biodiversity.

This unit demonstrated that it is possible to take an ethical "pulse" of students on complex scientific topics. I would argue that due to the unprecedented rate of habitat destruction, loss of species, acidification of the ocean, and difficulties in protecting endangered species (5), it is imperative that all those teaching biodiversity, biology, or ecology

TABLE 1.
Use of learning cycle incorporating features key to completing the biodiversity and ethics unit.

Learning-Cycle Element	First-Time Used or Unique Lesson Element	Comments on First-Year Use	Opportunities for Improvement
1. Engage – Part I	Engaging prior knowledge NATURE video, <i>The Loneliest Animals</i> Class discussion: visits to zoos, and other areas of diversity	Both video and discussion immediately engaged students and raised their curiosity about the lessons to come	Capture sheets needed for discussion and to introduce vocabulary
1. Engage – Part II	Ethics and values survey	Definitely include in subsequent years; first time ethical considerations were introduced into science curriculum; gave survey pre- and post-lessons	Need to offer more questions regarding lack of value to gain other opinions on biodiversity; give initial survey at beginning of year
2. Explore	Black Rock Reptiles – invited to present extant reptile diversity and endangered species in the classroom, to each class	First time living animals were made available directly to students in small groups, assuring individual encounters and explanations of conservation and protection	Would certainly use them again; however, would have students use experience to explain why or why not protection of such animals is important
3. Explain	Endangered species posters	Successful; very original slogans; clear understanding of organism and challenges it faces	Greater application of prevention and assessment; accompanied by oral presentation
4. Evaluate – Part I	Evaluate competing design services for maintaining biodiversity	Only touched on	Would assume much larger role with design rubric done by groups of four students
4. Evaluate – Part II	Examples of design solution constraints could include scientific, economic, and social considerations	Social considerations were addressed via the survey; other areas were not looked at	Need to develop and test in subsequent years
4. Evaluate – Part III	Elaboration and discussion of ethics results	Able to review ethics survey in an aggregate and individual manner	Have more time for synthesis of findings and student debate

TABLE 2.

Example survey question to gauge ethical choices among students before and after presentations and visit to class of 15 species of reptiles.

Survey Questions	# Agree (Before)	# Agree (After)	# Disagree (Before)	# Disagree (After)
I3. The visit by Black Rock Reptiles and 15 animal species greatly increased my awareness of biodiversity and threats to wildlife habitats.	-----	60	-----	9

take time to educate and help students with ethical decisions they face regarding the current extinction as a counter force to the indifference seen regarding the natural world, as identified by Wilson (6).

Further analyses of the various lessons/activities for this unit are presented in Table 1. The unique features of the unit are being evaluated after this initial trial year to see how they might be improved or modified for those seeking to include ethical implications for biodiversity.

SUPPLEMENTAL MATERIALS

Appendix 1: List of Black Rock Reptile (www.blackrockreptiles.com) species for classroom notes and observations

Appendix 2: Survey questions to gauge ethical choices among students before and after presentations and visit of 15 species of living reptiles to the class

ACKNOWLEDGMENTS

The author wishes to thank the Parkland Student Teaching Association for a funding grant enabling the Black

Rock Reptile demonstration to occur in my classroom. The author declares that there are no conflicts of interest.

REFERENCES

1. **Barnosky, A. D., et al.** 2011. Has the Earth's sixth mass extinction already arrived? *Nature* **471**:51–57.
2. **Coe, M. A.** 2001. The 5 E Learning Cycle Model. MSU Inquiry Approach. [Online.] <http://faculty.mwsu.edu/west/maryann.coe/coe/inquire/inquiry.htm>.
3. **Cohen, J. I. (ed.).** 1999. Managing agricultural biotechnology: addressing research program needs and policy implications. CABI Publishing, Great Britain.
4. **Eldredge, N.** 2001. The sixth extinction. An ActionBioscience.org original article. American Institute of Biological Sciences. [Online.] http://endangeredink.com/programs/population_and_sustainability/extinction/pdfs/Eldridge-6th-extinction.pdf.
5. **Kolbert, E.** 2014. The sixth extinction: an unnatural history. Henry Holt and Company, New York, NY.
6. **Wilson, E. O.** 2006. The creation: a meeting of science and religion. W.W. Norton and Company, New York, NY.